Pearson BTEC Level 3 Nationals Certificate, Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Learner Registration Number

Time 40 minutes

Paper reference **31617H/1P**

Applied Science/Forensic and Criminal Investigation

UNIT 1: Principles and Applications of Science I

Physics

SECTION C: WAVES IN COMMUNICATION

You must have:
A calculator and a ruler.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The exam comprises three papers worth 30 marks each.
  Section A: Structures and functions of cells and tissues (Biology).
  Section B: Periodicity and properties of elements (Chemistry).
  Section C: Waves in communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- The formulae sheet can be found at the back of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P64277RRA

©2021 Pearson Education Ltd.

1/1/1/1/1/1/1/1/1/1/

P 6 4 2 7 7 R R A 0 1 1 2

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) Figure 1 shows a transverse wave being produced on a string.

Figure 1

Figure 2 shows the displacement of the string as the wave travels along the string.

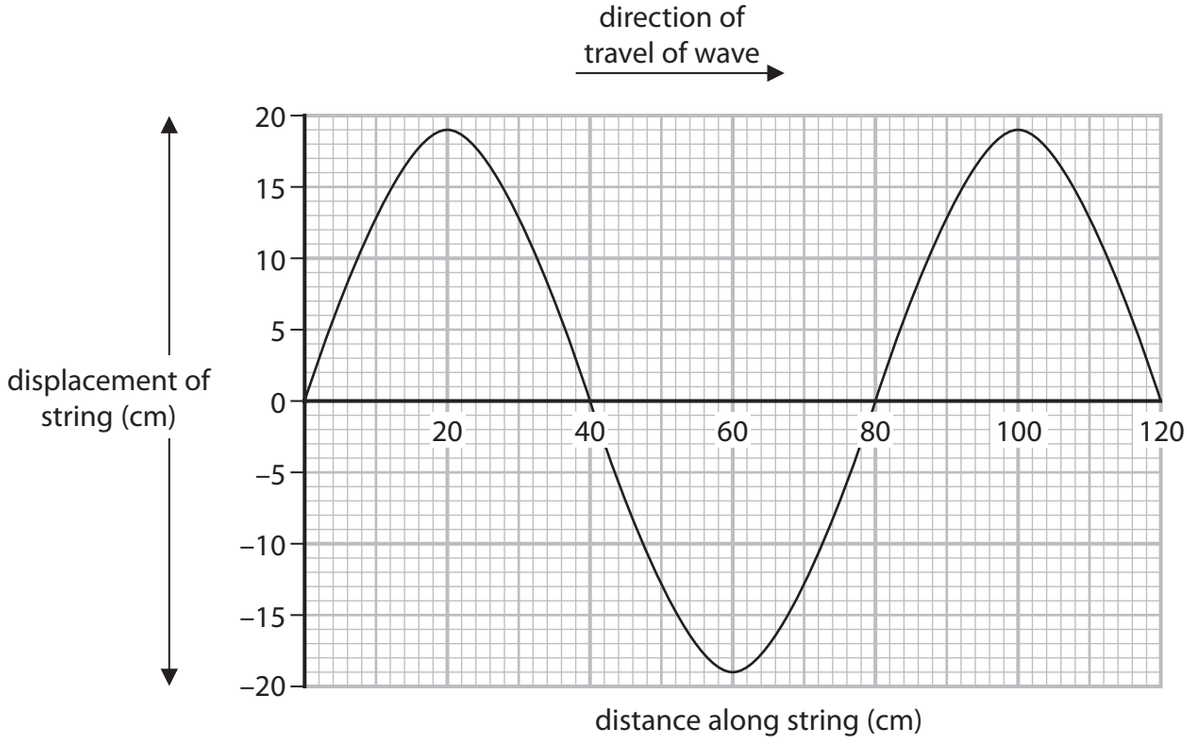

Figure 2

(i) Give the amplitude of the wave in Figure 2.

(1)

amplitude = ... cm

(ii) Give the wavelength of the wave in Figure 2.

(1)

wavelength = ... cm

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) A different transverse wave has a wavelength of 1.8 m and a frequency of 16.0 Hz.

Calculate the speed of this wave.

Use the equation: $v = f\lambda$

(2)

speed of wave = ... ms^{-1}

(c) Figure 3 shows two waves.

The waves have a phase difference of a quarter of a wavelength (¼ λ).

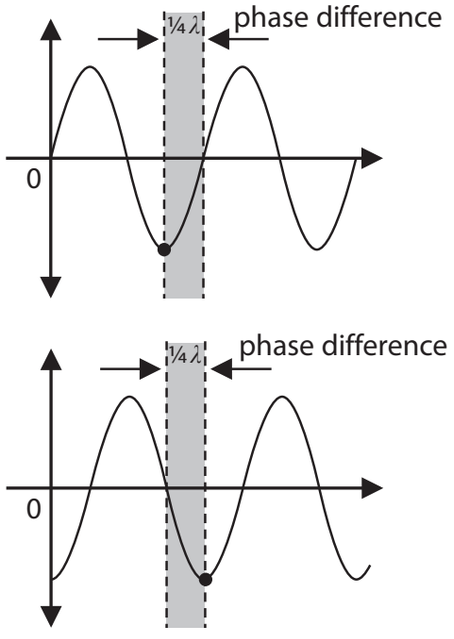

Figure 3

Which angle is the same as the phase difference shown in Figure 3?

(1)

☒ **A** 45°

☒ **B** 90°

☒ **C** 180°

☒ **D** 360°

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(d) Waves can either be transverse or longitudinal.

Complete Paragraph 1 to describe the motion of the particles in the **two** types of wave.

(2)

In a transverse wave the particles move .....

to the direction of travel of the wave.

In a longitudinal wave the particles move .....

to the direction of travel of the wave.

Paragraph 1

(Total for Question 1 = 7 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

2 Some analogue signals are converted to a digital code for transmission.

Figure 4 shows the analogue voltage input and the digital output code for an analogue-to-digital converter.

The converter splits the one volt of analogue input into eight parts of digital output.

Each part of the digital output is given a code.

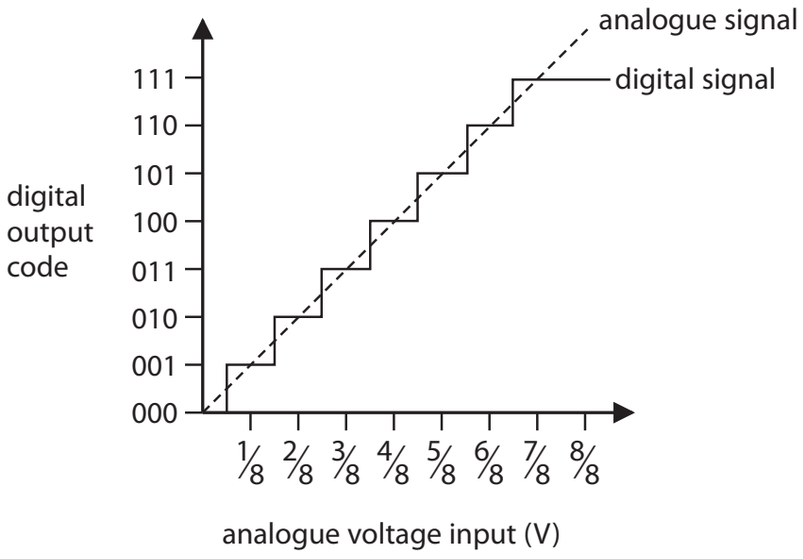

Figure 4

(a) (i) Which is the digital output code for $\frac{5}{8}$ V?

(1)

- ☒ **A** 011
- ☒ **B** 100
- ☒ **C** 101
- ☒ **D** 110

(ii) Information can be transmitted as a digital signal or an analogue signal.

Explain **one** advantage of transmitting information as a digital signal.

(2)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(b) A person switches on a computer and the computer accesses the internet.

Describe the process a computer uses to access the internet through a Wi-Fi connection.

(3)

(Total for Question 2 = 6 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

3 Figure 5 shows four diagrams of a ray of light passing through a glass block and hitting a glass-air boundary at the critical angle.

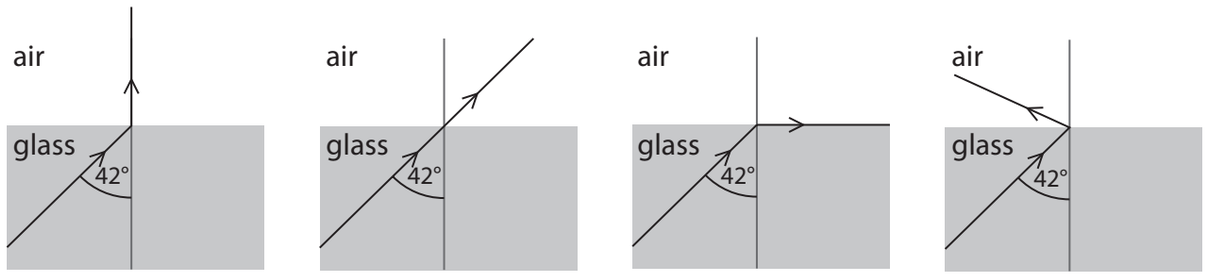

Figure 5

(a) Which diagram in Figure 5 shows the correct path for the ray of light?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) Figure 6 shows a ray of light inside part of an optical fibre.

The critical angle for this glass-air boundary is 42°.

Draw a line on Figure 6 to show the path of the ray of light from point X as the ray of light travels through the optical fibre.

(2)

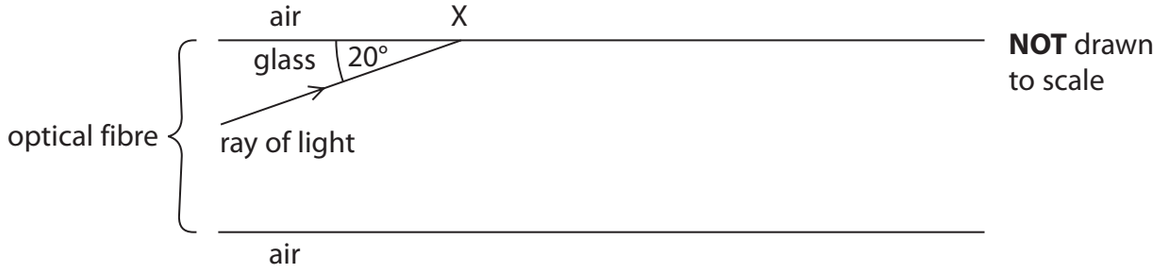

Figure 6

(c) Give **one** medical application of optical fibres.

(1)

.....

.....

(Total for Question 3 = 4 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

4 (a) A learner has two pipes of the same length, L.

One pipe is open at both ends and the other pipe is closed at one end.

Air is blown into each pipe to produce a standing sound wave.

The standing wave gives a sound of specific frequency (pitch).

Figure 7a shows the standing sound wave in the open pipe.

Figure 7b shows the standing sound wave in the closed pipe.

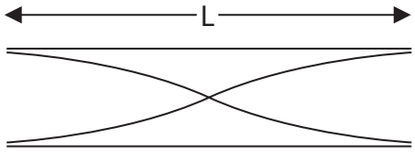

Figure 7a

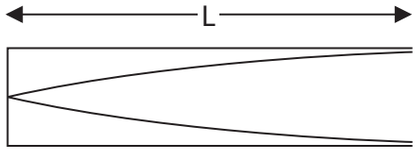

Figure 7b

Explain why the closed pipe in Figure 7b produces a sound with a lower frequency.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The intensity of a sound produced by a loudspeaker varies with the distance from the loudspeaker.

The intensity of the sound at a distance of 2.5 m from the loudspeaker is 1.0×10^{-5} Wm^{-2}.

Calculate the distance from the loudspeaker where the intensity of sound is 5.0×10^{-10} Wm^{-2}.

Use the equation:

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

(4)

distance from loudspeaker = ... m

(Total for Question 4 = 7 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

5 Mobile phones use waves with a range of frequencies in the microwave region of the electromagnetic spectrum.

Compare the advantages and disadvantages of using microwaves for mobile phone communication.

(6)

(Total for Question 5 = 6 marks)

TOTAL FOR SECTION C = 30 MARKS
TOTAL FOR EXAM = 90 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Formulae sheet

Wave speed $v = f\lambda$

Speed of a transverse wave on a string $v = \sqrt{\frac{T}{\mu}}$

Refractive index $n = \frac{c}{v} = \frac{\sin i}{\sin r}$

Critical angle $\sin C = \frac{1}{n}$

Inverse square law in relation to the intensity of a wave $I = \frac{k}{r^2}$

$$\frac{I_1}{I_2} = \frac{(D_2)^2}{(D_1)^2}$$

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE